Biodistribution of ^{18}F -FDG After Oral Administration to a Honeybee: PET/CT Proof of Concept

TO THE EDITOR: I would like to report proof of concept of a novel application of PET/CT in insects. Understanding glucose metabolism in the honeybee provides an insight into phenotypic physiologic adaptations under varying stressful conditions. Bees require either stored honey or nectar to survive, with limitation to access being fatal within 24 h. Various sugars can be used as a source in the absence of natural nutrition. The bee digests nutrients, which are circulated in the hemolymph to be used as energy or stored in the fat bodies, and varying levels of protein glycation occurs under different stress conditions.

Insects are exempt from animal ethics and this provides a large accessible population for research. Few human disease processes, however, translate to insects. Neurotransmission and glucose metabolism are 2 promising areas of research. Metabolic pathways in bees provide rich insight into human metabolism and may unlock insights and understanding around glucose metabolism in diabetes, shaping treatment. Indeed, the insect model allows large-scale controlled interventional studies, for example, with metformin.

Iodinated glucose has previously been used to image metabolic pathways in bees (1). Limitations of autoradiography, iodinated radiopharmaceuticals, and imaging the living specimen saw the role of PET imaging with ^{18}F -FDG examined for feasibility. This study aimed to evaluate the potential for PET imaging of ^{18}F -FDG to provide visual and quantitative mapping of postdigestion glucose biodistribution.

METHOD

Assessment of the capacity of the CT component of the Sofie Biosciences Genesis 8 (G8) PET/CT system to image bees was undertaken without introducing a radiotracer. Fifteen nurse bees were collected from the hive and were immobilized at -10°C for 15 min. Standard CT imaging was performed on the G8 (Fig. 1). After successfully demonstrating the capability of the G8 to image bees with the CT component, the ^{18}F -FDG study was undertaken. Ten nurse bees were collected from the hive and deprived of food for 2 h. The bees were then afforded a drop feeding individual bees from a syringe containing concentrated ^{18}F FDG (Fig. 2). After feeding, bees were immobilized at -10°C for 15 min. Bees were loaded abdomen first into a drinking straw (Fig. 3) in batches and imaged for 10 min on a

FIGURE 1. CT images of a handful of bees demonstrated G8 CT capability.

FIGURE 2. Drop feeding ^{18}F -FDG by syringe.

FIGURE 3. Loading bees into a straw for imaging.

FIGURE 4. PET/CT image of bee demonstrating movement of orally administered ^{18}F -FDG into the hemolymph and distribution to flight muscles and brain.

G8 PET/CT system. CT was used to coregister ^{18}F -FDG biodistribution. Insects are exempt from animal ethics requirements.

RESULTS

Individual bees fed at different times and volumes, which produced variable imaging appearances. In terms of proof of concept, the G8 PET/CT system was able to image and localize the biodistribution of ^{18}F -FDG in the bees. The G8 system allowed identification of ^{18}F -FDG biodistribution in the hemolymph, proventriculus, ventriculus, fat bodies, flight muscles, and brain (Fig. 4).

CONCLUSION

This study demonstrated the feasibility of using PET/CT to map oral accumulation and biodistribution of ^{18}F -FDG as an analog of natural energy sources. Further analysis in live bees, including after metformin intervention, is feasible using PET/CT.

DISCLOSURE

No potential conflict of interest relevant to this article was reported.

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REFERENCE

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